(2)

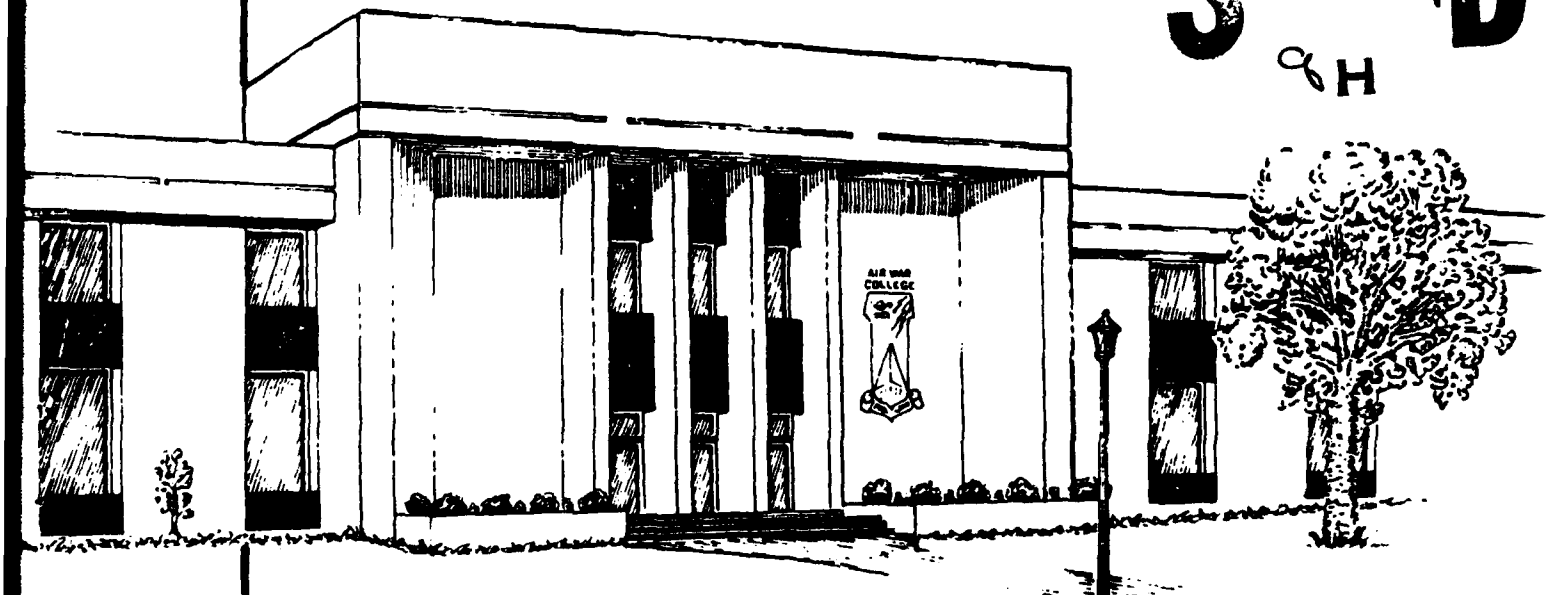
AIR WAR COLLEGE

RESEARCH REPORT

No. AU-AWC-88-169

WAR GAMES AND LOGISTICS

By LIEUTENANT COLONEL DERYL S. McCARTY



AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

AIR WAR COLLEGE
AIR UNIVERSITY

WAR GAMES AND LOGISTICS

by

Deryl S. McCarty
Lieutenant Colonel, USAF

A RESEARCH REPORT SUBMITTED TO THE FACULTY

IN

FULFILLMENT OF THE RESEARCH

REQUIREMENT

Research Advisors: Colonel Paul T. Welch
Colonel George W. Tiller

MAXWELL AIR FORCE BASE, ALABAMA

April 1988

DISCLAIMER

This research report represents the views of the author and does not necessarily reflect the official position of the Air War College or the Department of the Air Force. In accordance with Air Force Regulation 110-8, it is not copyrighted, but is the property of the United States Government.

Loan copies of this document may be obtained through the interlibrary loan desk of Air University Library, Maxwell Air Force Base, Alabama 35112-5564 (telephone: [205] 293-7223 or AUTOVON 875-7223).

AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: War Games and Logistics

AUTHOR: Deryl S. McCarty, Lieutenant Colonel, USAF

Discusses the history, precepts, and educational outcome of war gaming in the military. It also discusses the history and experience of military logistics in war. The report then posits that the war game educational experience is not being gained through the war games now being offered in the Air War College curriculum, using the 1987 Theater War Exercise (TWX) as the model. The report concludes by suggesting several logistics simulation models now in use by the military that could be appended to the TWX to make that war game more realistic and add to the professional educational experience of the students.

BIOGRAPHICAL SKETCH

Lieutenant Colonel Deryl S. McCarty (M.S. Logistics Engineering, Air Force Institute of Technology) is a Certified Professional Logistician who has spent his professional career in aircraft maintenance from unit to Air Staff level. His assignments have included strategic and tactical airlift maintenance units as well as tactical fighter maintenance units in Taiwan, California, Delaware, Illinois, Washington, Hawaii, and the Philippines. He is a graduate of the Squadron Officer School and the Air Command and Staff College. Lieutenant Colonel McCarty is a graduate of the Air War College, Class of 1988.

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

War games, in virtually every culture, have been around as long as has mankind. Since antiquity people have invented and played war games for entertainment, education and sport.(1:115-127) Chess, Go, Chaturanga (a Hindu game), Risk, Axis and Allies, Blitzkrieg, and a host of new home computer games now entertain both young and old and result in considerable profit. But war gaming for the military is--and always has been--serious business.

What are war games, why are they serious business, what do we expect from them, and what are we getting? Addressing these questions is the general purpose of this research. But it will go further to propose that if, in areas like logistics, we are not getting what we need, then what kinds of factors should be considered in designing war games to correct that flaw?

At this point the author admits to a bias. His background, education, and experience all suggest that we in the Air Force do not focus enough attention on logistics and its relationship to strategy and tactics. Furthermore, he believes that war gaming in the Air War College (AWC),

specifically the Theater War Exercise(TWX), should provide some of the critical training for future air war leaders, and that training does not adequately reflect combat logistics. Therefore, we are not training well and are allowing those future leaders to draw conclusions about war that could lead to disaster.

This paper is divided into several chapters which discuss the posed questions and consider logistics and wargaming at the AWC. These chapters address: war gaming (what it is and what is isn't, why war games are important to the military, what the players and the institutions should derive from the play of the games, and what drawbacks exist that players and institutions *must compensate for*); logistics (what it is, why it is important to war fighting, and how logistics effects strategy and tactics); TWX 87 (what it was and how it did or didn't incorporate logistics and war gaming precepts); and a conclusion that would suggest--in general terms--logistics models that future Air War College war games could use to insure that the training given via the games reflects the best we know of Clausewitzean battlefield reality.

CHAPTER II

WAR GAMES

At the Battle of Maldon, England, A.D. 991, the English commander is credited in poetry as referring to his troops as "those softhearted warriors at the war play"(1:115). This "enshrined in Western tradition the view of war as a kind of game."(1:115) The games that were subsequently invented and played mostly by the kings and princes of Europe during the next millennium were Chess derivatives that not only reflected the play of war, but seemed to determine how war would be fought by the soldiers of those same kings and princes. "In the real wars of the seventeenth century, armies fought in tight formations, following tactics as formal as the moves in chess."(1:116) New Kriegsspiel, a game developed in the eighteenth century in Germany, was probably one of the first formal war games that received widespread military acceptance. In fact, while watching the play of New Kriegsspiel in 1824, the Chief of the German General Staff exclaimed, "It's not a game at all! It's a training for war."(1:116) He thereupon ordered every regiment in the Prussian Army to play the game regularly. This German game was imported to the United

States in the 1880's and under the name of American Kriegsspiel became the first "specific game to receive serious attention", "and its stay--particularly for the Navy--would be permanent and pervasive."(1:119)

War Games--what they are

"A war game is a warfare model or simulation whose sequence of events is interactively affected by decisions made by players representing opposing sides, and whose operation does not involve the activities of actual military forces."(15:44) While this definition is dry, it does outline some key features of war games. The first is that the subject is war, war fighting, campaigns, and battles. The second feature is that the model is interactive, i.e. that there are two players or groups of players who are independent, interdependent (they each must act and react to each other's moves and decisions), and opposing. Another feature of war games is that they tend to be stochastic, i.e. the outcome of the decisions made by the players are dependent not only one the decisions themselves but also on the roll of the dice. Because of this latter feature the outcomes of the players' decisions are usually not strictly repeatable. As opposed to purely mathematical models or simulations, once a decision is made and the die is cast, there is not a way to "replay" the effects of a decision nor

recant on its effects. Dice rarely repeat themselves, nor does war. In other words, once players have made a decision to invade a certain terrain or attack a certain group of forces, then the dice determine how many grids your forces advanced or how many soldiers, tanks, or planes you lost or won. Basically the dice determine the specific effects of a given decision. The value of war gaming, therefore, is that the players learn the process of making decisions and having to live with or compensate for an irrevocable result.(15:44-46)

Certainly war games can take many forms. In the main, however, many games take the form of boards or maps, often with squares or hexagons marked on them to identify a specific location. The German New Kriegsspiel was played on a board of 3600 squares that curiously resembled the German-French-Belgium border area. A quick glance at the hobbyist and entertainment war games now available on the market reveals many board formats that can represent fictitious or actual national or political borders, past, present, or future. In the final analysis the form of the game is not critical, each form will certainly have its pluses and minuses depending on who is playing it. The key factors, therefore, "are players and decisions. Fundamentally, war gaming is an experiment in human

interaction and is best used to investigate processes, not to calculate outcomes."(15:44)

War Games--what they aren't

Although war games can include much sophisticated mathematics, they are inherently not predictive. Predictive modeling is the province of operations research (OR). The function of OR, which in some military circles is also called systems or campaign analysis, is to determine the "what if's" and their likely outcomes. In other words, given this scenario and this current force posture, what if one side did this? What if they did that? Whatever the answer, the OR operator can change the input and replay or restudy the model. What if I had changed that input? What if I had doubled this and halved that? On the other hand, a war game move outcome cannot be changed because it is a unique blend of a player decision (which may be changed or repeated) and the roll of the dice (which may not necessarily be repeatable.)

The basic drawback to the OR predictiveness is that the model depends on assumptions and methodology that are subjective. To determine, therefore, that something will occur if this or that parameter is changed may not be valid if the input variables or the mathematical model must ultimately depend on unquantifiable human dimensions. In

war this can equate to courage, fear, morale, and the like which are certainly identifiable, but not quantifiable.(15:25)(7:58)

War Games--what can they do?

If war games cannot predict the outcome of war or battle then why play them? While it is true that there is not predictiveness in war games, that is not to say that there is not predictability to the outcome if certain decisions are made and the rules are known. The rules of a war game are certainly designed to reflect, as much as is possible, the real world. Rules, such as how far an infantry unit can march in one day, and under different circumstances such as heavy fighting or high mountains, are all determined in advance based on what we know of that scenario from past experience. War game designers spend much of their time researching the "reality" of the underlying rules so that if a player makes a choice or decision, even though the roll of the dice will determine a specific outcome, that outcome will roughly mirror the world's experience in warfare in that situation. It is these researched "reality" rules that determine the rough outline of what can happen if two forces of these characteristics and under these circumstances meet in conflict. The dice serve to mirror the Clausewitzean fog

and friction of war and therefore serve to determine a specific outcome, only within the guidelines established by the "reality" rules.

If, therefore, the outcome of a given "reality" rule/player decision/die cast can roughly mirror the reality of the world, there is some predictability to the effect of player decisions. War gaming has consistently used this fact to improve the players' chances of "winning" by determining what factors in the real world--which equate to the "rules" in the game--can be changed or modified. Consider some examples of how war games helped to make war fighters increase their odds.

In the early 1900's the war gamers at the Naval War College continually fought a Blue (U.S.Navy) versus Red (British) war in the Atlantic and Caribbean. While the Blue forces could and did take their island targets with great regularity, they could never win at sea in fleet battles against the British Fleet.

> But in playing out the plans, the Blue Fleet was always beaten by the Red. The Blue Fleet, threatened by the Red Fleet's long-range guns, could not get close enough to fire effectively, and if the Blue Fleet did get close enough, it would be in a "fatal zone". At least partially as a result of these war-game battle losses, U.S. warships got steel deck plates, guns were given higher elevations, and long-range gunnery training was stepped up. By 1938 the Blue Fleet's guns out ranged the Red Fleet's by 10,000 yards, and in Newport war games Blue began winning against Red. (1:121)

History is replete with similar "successes" from having played war games in headquarters and academies. For example, the below-the-water-line armor plating thickness formulae for U.S. Naval vessels was determined and improved as a result of consistent war game "losses". The precise tactics for the Japanese attack on Pearl Harbor and the Battle of Midway were both planned and executed as a result of the Imperial Japanese naval war games of the same subject matter. In 1905, the British in gaming a hypothetical German invasion through Belgium "discovered some mobilization and logistical problems that were solved in time for the real mobilization for war."(1:121)

Between 1919 and 1941 the Naval War College played 136 war games, of which 127 involved the Blue forces against the Orange (Japan). The U.S. Naval leaders who actually fought in the Pacific Theater in World War II were also the ones who played the war games during the inter war period. It was Fleet Admiral Chester Nimitz, after the war, who said, "The war with Japan had been re-enacted in the game rooms at the Naval War College by so many people and in so many different ways, that nothing that happened during the war was a surprise...absolutely nothing except the kamikaze tactics toward the end of the war; we had not visualized these."(2:47)

While this was certainly true, it down plays the role of war gaming in actually solving, or rather reducing the impact of the kamikaze problem. It was during the height of the attacks that the war gamers at the Naval Academy modeled the attacks and through some sophisticated mathematical gaming techniques developed methods of coping with these kamikazes. The result was the dictum that if the kamikaze is coming in low turn the ship's beam away from the attacker, and if it comes in high the ship was to turn into the attacker.(1:131)

War Games--what they can't do.

Recall that war games are not predictive. Therefore one could not expect that to "win" in a war game, even consistently, would guarantee the "win" in the real battle. That a win often occurs is more the result of having had the practice of having made the decisions and seen the potential outcomes and having made an in depth study of the terrain that allows the war game practitioner to win in the real war. The Japanese, in war gaming the battle of Midway, continually cried foul when the game umpires declared that two of the attacking Japanese aircraft carriers were declared sunk by the defending Americans. No such thing could occur in real life, the players said. The umpires relented and the aircraft carriers, which were

coincidentally the Akagi and the Kaga, were "restored" to duty. In subsequent Midway war games:

> The verdicts of the umpires regarding the results of air fighting were similarly juggled, always in favor of the Japanese.
>
> A month after the games, the real battle of Midway was fought. The Japanese did attack Midway, and land-based U.S. airplanes did attack the Japanese force, but to little effect. Planes from U.S. carriers proved to be the real ship killers. Those planes, which had played no role at all in the juggled game, sank the Kaga and the Akagi, and the two other large Japanese carriers. The United States lost one carrier and a destroyer. As the Japanese game had predicted, the battle would be decisive. But the game had been rigged to pick the wrong winner. (2:48)

War Games--a summary

War games have been played throughout our history not as a predictor of the outcomes of wars and battle but to teach those who must lead forces into battle the "hows" and "whyfors" of making decisions in war. One author described war games as teaching the military leaders of the day what they didn't know that they didn't know.(1:59-78) A final report illustrates this point.

In the beginning of the Atlas intercontinental ballistic missile (ICBM) program the Air Force wanted to base the missile above ground.

> And the Atlas-A was really a pressurized balloon. You had to put gas into the skin because it was so thin it wouldn't hold itself up. Rand [The Rand

> Corporation] put together a simulation and set the ground rules: 'We're going to play the Soviets. You, the Air Force, are going to play the United States. These are your forces, and they are at these locations, and we've got 120 ICBMs and this is the population density around your cities, and so on. And there's a crisis. As the crisis evolves, the game will begin here.'
>
> The first thing the Rand computer did was launch a [Soviet] strike against all these [U.S.] ICBMs. They were one-quarter of a psi hard [able to withstand an increase in pressure of only one-quarter of a pound per square inch.] If you got within five or ten miles of them with a nuclear blast you'd kill them. So in one single strike the Soviet Union disarmed the U.S. retaliatory force. The Air Force cried 'Foul! Wait! That's not fair. You didn't tell us this would happen!'
>
> This is when people didn't think about strategic forces. Here was a real value for this game. It gamed some insights. The Air Force said, 'We didn't think about that.' 'Well,' Rand said, 'Now you are thinking about it.'(2:45)

It was war gaming of this type that "taught" World War II naval officers what to expect from the forces of Imperial Japan. It was this type of war gaming that "taught" Air Force leaders at the beginning of the missile era what they could expect, in theory, from an enemy determined to undo our intercontinental ballistic missile threat. It is war gaming of this type that could teach U.S. leaders of tomorrow what they could expect from today's equally determined and equally armed Soviet adversary.

But war game outcomes, and thereby the instruction given to the players, is a combination not just of the roll

of the dice and the decision of the players. It is also dependent on the "reality" rules. These can not only proscribe the limits of a given contest, but may include some of the circumstances under which an unexpected outcome could occur: a much smaller force defeating a much greater one because the conflict occurred in a narrow defile (Thermopylae); or, a large, determined tank army losing to a cold, dug-in infantry at least partially because of a lack of fuel (Battle of the Bulge). This lack-of-fuel "reality" rule is part of a larger "reality" rule called logistics--the supplying of an armed force in the field. The next chapter will discuss this logistics "reality" rule in detail.

CHAPTER III

LOGISTICS

Logistics has been an integral part of war from antiquity and has also been constantly changing. Consider the relatively modern French major general des logis (from which comes the word "logistics"). His function was to get lodging for the troops and to direct the march to the battleground.(19:iv) During these early years fodder and food were taken from the enemy populace, and the weapons were, along with the horse, provided by the soldier. In 1870, during the Franco-German War, logistics came into the modern ages with a shift from "predatory logistics" to one in which the army was constantly supplied from a fixed base.(21:232) But supplying the army in the field is not the full definition of logistics because it does not begin to give the flavor of the vast enterprise that logistics must be for success in war. Therefore, for the purposes of this paper let us define logistics, confine it to a theater or campaign, discuss what it does, and conclude with a look at why logistics is important to war fighting and to strategy and tactics.

Logistics-a definition

Admiral Henry Eccles, the pioneer logistician and thinker defines military logistics as "the supplying of men and material, and the rendering of services, to the operating military forces."(9:49) This definition is necessarily broad because it covers virtually every service and physical provision known to the soldier. In the definitive work by the Department of the Army in 1947 that recounts the logistics activities in World War II, the Army defined logistics as:

> "that branch of military art which embraces...procurement, storage, and distribution of equipment and supplies; transport of troops and cargo by land, sea, and air; construction and maintenance of facilities; communication by wire, radio, and the mails; care of the sick and wounded; and the induction, classification, assignment, welfare, and separation of personnel."(13:vii)

While this definition is more specific, it includes much more than is commonly accepted as "logistics" in today's Air Force which excludes civil engineering, communications, medical, and personnel activities.

For our purposes perhaps it would be instructive to define today's logistics in a theater construct since our war plans and war games are written, published and played in that vein. Theater combat logistics is, therefore, the provision of the material and services of war to the troops in a theater of war or a campaign. This definition would

include the following: maintenance of equipment and aircraft, supply and distribution, transportation, and procurement and payment of services, equipment, and parts from local civilian industry. This theater logistics definition would not include acquisition from our national industrial base nor transportation from the industrial base to the theater of operations.

This definition necessarily limits logistics to a local theater of combat operations, limits it to only maintenance and provision of direct war fighting assets, and, for purposes of this paper only, limits logistics to war games and plans of one service, in one area, and with an assumed infrastructure (or not as in the case of a contingency operation.) With that as a basis for discussion, what is it that logistics does?

Logistics--what does it do?

Each of the sub-areas in the definition of theater logistics has a role to play in war, both independently and in combination. Let's look at each area (with the exception of local civilian procurement) and draw some conclusions as to what that area contributes to the overall war effort.

Maintenance. After the command element determines what targets are to be attacked and with what assets, the next activity that must be accomplished is to generate the

assets needed to perform that mission.(3:2-18-2-19) That is the first function of the maintenance portion of the logistics system. Maintenance personnel must therefore bring the selected fighting assets up to designated war fighting potential and arm and protect those assets until required for use. After use, those same assets must be returned to fighting capacity which is the second and more traditional function ascribed to maintenance. This repair activity must include not only the regeneration of fighting assets for the new targets selected by command after the first strike, but the repair and recovery of aircraft and equipment that may have been damaged. Organizationally, the Air Force has also determined that the generation, storage, and delivery of munitions is also a function of maintenance. Interestingly, this broad function of munitions maintenance is the least automated, most manpower intensive function in the Air Force. But both of these activities assume a broader logistics infrastructure. For example, there must be a supply point to expedite the repair of damaged assets. there must be a system of delivery for those spare parts, and there must be a system to provide command and control to the maintenance, supply, and transportation functions so that they are integrated smoothly. (11:665)

Supply. To effectively insure that aircraft are repaired quickly, spare parts must be available when and

where needed. If not, or if the storage point is destroyed, or if the spares involved are more economically stored elsewhere, there must be a system to locate and distribute the needed assets quickly. Dispersion of the spares is critical to insure that one hit does not destroy the entire supply cache.(11:661-662)(8:28-30) This premise, however, means that the supply system within the theater, and perhaps even back to the industrial base, must have an inventory control and reliable communication system to insure that the needed part is quickly located and delivered to the maintenance function performing the generation of fighting assets. The Air Force supply organization includes provision of fuel and lubricants as well. This would assume, therefore, that fuel storage is protected or dispersed as well as is its attendant delivery system. In addition to war fighting spares, the supply system must also be able to supply the administrative and personnel support items needed for continued operation. This would include not only paper and pencil, but tools and spares for aircraft test and support equipment as well.

Transportation. Moving equipment, spares, and people to and from maintenance and arming areas, delivery of spares, fuels, and munitions in the theater as well as locally is the critical link in the logistics network.

> Probably the most common limiting factor in U.S. Army logistics has been transportation. Whenever shortages of supplies or equipment have appeared at the battle fronts, from the Revolutionary War to the Korean War, more often than not it has been the result of some shortage in transportation somewhere along the line.(11:667)

Why is logistics important?

History is replete with lessons and warnings similar to the following, as expressed in the U.S. Army's official World War II history:

> The roles played by strategy and tactics, by military leadership, and by the man in combat are well known. Important and decisive as they were, they were completely dependent upon adequate logistic support. Moreover, logistic limitations in many cases dictated our strategy, as well as the type of campaign to be fought and the timing of its initiation.(13:244)

In other words, what a commander or political leadership wants to do (strategy) through the specific use of military forces (tactics) is almost totally dependent on what there is to do it with (logistics). This is true at the flight-element level: (You break right, go down 2500 feet, level off and come at his face. I'll break left, climb to 10000 feet, swing out 5 miles and come in from the sun behind him...uhh, that is if you have any missiles or fuel left.) This is also true at the aggregate level. In the American Civil War, for example, the Confederate Union's brilliant leadership (Robert E. Lee), strategy (bleed the

North until it is no longer interested in preserving the Union), and tactics (cavalry maneuver and heavily fortified Virginia redoubts) were not sufficient to prevail over the logistics and industrial capability of the North and the partial denial of some Southern logistical capability through the naval blockade of Southern ports.

The history of airpower is full of examples where an important strategy of one nation is to deny the logistics base of the opposing side. The whole concept of interdiction, whether right behind the battlefield or further behind where the "follow-on forces" are staging, is designed to deny the enemy his own logistics. Airfields, ball bearing factories, heavy-water manufacturing plants, tank parks, aircraft maintenance facilities, and supply warehouses have been and will probably continue to be prime interdiction targets.

To further underscore the importance of logistics there are counter interdiction strategies. Consider those of North Vietnamese General Thanh.

> For nearly four years, [the USAF's] Operation Rolling Thunder sought to strangle the insurgency in the South by cutting off the flow of logistical support from North Vietnam. The effort was unsuccessful because it was countered by a Vietcong strategy that embodies the principle of synchronized support--General Thanh's "tactical defensive." Under this concept, the timing and tempo of offensive operations were precisely

> regulated by the availability of resupply....(19:167)

If "the principle manifestation of war--or portrayal of its physical essence--is logistics" (4:9) then clearly our war plans (and war games) should reflect an active and ongoing interest in logistics. There should be an obvious and consistent methodology for determining that our logistics base in at least the structured theaters of war (the Pacific, Europe, Middle East, and South and Central America) is adequate, responsive, flexible, and sustainable. But is there that active training and testing program for logistics? The next chapter will address that question.

CHAPTER IV

THEATER WAR EXERCISE (TWX)

The TWX is a ten year old computer assisted war game played by each year's Air War College class. It is designed to simulate a theater air battle in NATO's central region. It is clearly stated, however, that though the war game is played in Europe the educational results are sufficiently general to let the players draw lessons that would apply to any air war in most of the designated theaters of war.(6:1) The objective of the war game is stated at the outset and seems to match the general intent of all war games: "decision making is what the exercise is all about."(6:1) The specific educational objective of the TWX 87 with regard to logistics is: "Comprehend the logistic factors for supporting and sustaining air forces in combat and the requirement for detailed planning and coordinating with operations."(6:2) But is that educational objective served by the actual play of the game? This chapter will describe the environment and general outline of the simulated war scenario in TWX 87, look in detail at its logistics play and rules, and determine if the logistics play mirrors enough of "real life" to provide the training intended.

TWX 87--the basics of the game.

TWX is played in two parts, the first from the point of view of the Commander of the Allied Air Forces Central Europe (COMAAFCE). Central Europe is thought to be the area that will include the most intensive air battles that may be fought in any East-West war, perhaps even the most intensive in history. From the AAFCE perspective the players are to develop the air strategy that will likely defeat the red forces in a conventional environment. Additionally COMAAFCE must determine what forces and airfields he can execute the fight from, what logistics support (petroleum, munitions, and spares) he has at that location to support the fight, and then he and is staff must publish a daily "frag" or mission order, called the air directive (AD), to the field, through the fighting numbered air forces, so that these numbered air forces can execute the announced COMAAFCE strategy.

The staff positions for COMAAFCE include operations (OPS), intelligence (IN), and logistics (LOG), (each with assistants). These are the staff agencies found in most headquarters around the Air Force and their functions are similar to those in the real world. The OPS staff is to recommend and develop the air strategy for winning the war in central Europe. The IN staff is to look at the enemy s

air order of battle (AOB) and determine from intelligence inputs what the intention of the red forces' commander is. The IN staff must also determine from AAFCE strikes of the day before what targets remain to be hit or destroyed on the subsequent day's missions. The LOG staff must look at the logistics supportability of the bases to determine if additional aircraft can be bedded down, whether there is enough ammunition of the right type to prosecute the war as is defined in the AD, and to plan for the future logistics capability of the bases to fight and with what aircraft. These latter factors actually go into the decision making for the determination of the AD for the day.(6:12-30)

The fighting air forces role represents the second part of the play of the game. Seminars and players stop playing their roles as COMAAFCE commander and staff and are broken down into the 2d Allied Tactical Air Force (2ATAF) and the 4th Allied Tactical Air Force (4ATAF). "The daily task of the ATAF staff if to implement COMAAFCE's Air Directive using the limited resources...at their disposal."(6:96) In effect each ATAF is to allocate the mission aircraft at its disposal to prosecute the war as outlined by the AD. While there is no logistics play at the ATAF level, (all seminar members are playing roles as commanders of one of the ATAFs (COMATAF) or as members of the ATAF OPS or IN staffs), there is continuing logistics play at the COMAAFCE level.

Logistics--rules and play.

The logistics play of the game involves managing three items: fuel, spare parts, and munitions, and their distribution system. The logistician controls the these items at the depot locations (resupply points) as well as at the air bases.

Spare parts are generic. In other words, there is only one kind of spare part and it fixes all aircraft ills. It applies to all aircraft, but is consumed at varying rates depending on aircraft model. Players must manage the spare parts so that each base has enough to support the number of sorties that are to be flown that day or are planned to be flown at that installation during the ensuing flying period. Spares are shipped via intratheater airlift, which is also managed by the logistician, or by surface transportation, though this latter mode can only be used during the pre-hostility phase of the war game (except POL).

Once the aircraft and sorties requirements are outlined in the AD, the logistician makes certain that there is enough wherewithal to support the next day's activities. If there is not, then the LOG staff "predirects" (a TWX 87 term which means a directed overnight resupply or redistribution effort) spares from the depots or an overage base to the deficient individual air base. If "predirected", the

spares are then assumed be on hand at that air base in time for the next day's activities--if there were enough spares at the selected depot and if there was enough transportation to get the spares to that location and if there is enough storage space at the destination to receive and store the spares.

Petroleum, oils, and lubricants (POL) is treated as one standard fuel type for purposes of the game; oils and lubricants are omitted. POL is pipelined to individual bases from a fuel depot, unless enemy action has overrun the air base, interdicted the pipeline, or interdicted the depot facility. POL is consumed at a given rate per type of aircraft per sortie. It is therefore incumbent on the logistician to insure that there is sufficient fuel on hand to support the day's flying activities. If there is not projected to be transferred through the pipeline enough POL for the next day's flying, an emergency fuel resupply can be directed using surface transportation or tactical airlift.

Munitions, of which there are ten distinctive types, are handled similarly. Using the normal predirect system (backed up by the emergency resupply system) various of the ten munitions items are transported to a given air base from the munitions depot. The ten types of munitions are designed to do different things for different kinds of missions. The are air-to-air missiles as well as

air-to-ground missiles and bombs. It is certainly important to monitor not only how many but what type of munitions are available at a given air base. Since only certain munitions are used for certain kinds of missions it is of critical importance that the right kind of munition be at the right installation so that COMAAFCE's strategy can be implemented. Re-roling, which mean changing the kind of mission that a type aircraft is to fly, frequently means changing the munitions that an aircraft will carry. This greatly complicates the job of the logistician, because it means that he may have been shipping the wrong munitions to the base and therefore the new re-roled mission may not be supportable.(6:83-85, 91-92)

Logistics Play--how real?

POL realism is as close to what the logistician will face in a real conflict as can be imagined. POL is basically generic and will, whether in Europe or Korea, come by pipeline from rather large, somewhat protected depots, or from off shore, moored tankers. Additionally, the POL pipelines are obvious interdiction targets and therefore air base and headquarters logistics personnel will be forced to make do, reallocate, repair tanks and pipeline, and worry about sufficiency for upcoming missions. Should pipelines be damaged or destroyed, however, surface transport would

likely be considered the best POL transportation method. In fact, rail systems, especially in Europe and Korea, would emerge as the predominant POL carrier followed by over the road systems. In TWX 87, however, POL resupply by air is a stated methodology. This would not be a wise use of airlift. More importantly, it would be practically impossible. The methods for using tactical airlift to ferry fuel only allows for loads of up to 25,000 pounds of POL per tactical airlift sortie which, depending on the model, is between one and two tactical fighter sorties. This one-for-one-plus airlift to fighter fuel tradeoff means that it could require all of the available airlift for the day in moving POL to a single fighter wing which is planning to fly 200 A-10 sorties the next day. Additionally, there are only 20 or so of the apparatus that fits in the C-130 aircraft to carry the fuel, not enough to supply a wing whose POL supplies have been cut off. In a non-NATO or non-Korean theater, however, other fuel transport methods would have to be considered. Probably ship-borne would prove to be the most effective and efficient means of providing that transportation, but it all depends on where the conflict is. Naval transport is also more vulnerable to interdiction and dependent, obviously, on having access to the sea.

Munitions, even with ten "types" provides some realism, but does not show the incredible "nightmare" of

non-compatible types of munitions that exist in the real NATO environment. French, English, Dutch, Belgian, and U.S. weapons may not fit on each other's aircraft, or where they physically can fit, they may not use the same electronic signals to arm, fire or guide the more modern weapons. Consider the following commentary.

> Let me give you an example of something which occurred when I took over the new Air Command created 2 years ago, Allied Air Forces, Central Europe.
> I was concerned with a lack of all-weather air capability to provide support for ground forces if the attack should come during a period of bad weather.
> As it turns out there is very limited all-weather capability in Allied Air Forces in Europe today. We had some limited capability with a system call LORAN Pathfinder, a highly sophisticated airplane with computers on board which could lead in less equipped airplanes to the area and bomb with some precision.
> I proposed the Chiefs of the German and British Air Forces that we conduct some missions so that their pilots could have training in this technique. They both enthusiastically supported this.
>
> The Chief of the Luftwaffe immediately made some airplanes available to see how the system would work.
>
> This would involve a U.S. pilot and an American Pathfinder leading German airplanes on his wing into the objective area to bomb in extremely bad weather.
>
> The German planes showed up for the test. Incidentally, in this case, they were American-build F-4's which made it quite compatible, of course, with the F-4 Pathfinder that would be taking them in.
>
> Then we discovered that we could not put U.S. bombs on that German airplane because there was no standardization in the racks and shackles.

> Since the computer in the Pathfinder airplane was set up for American bombs with the proper ballistics for those bombs, it was impossible to take them into that kind of mission.
>
> You can picture what would happen if we had a real situation, a real attack, and had to do this kind of a job where the bombs would not fit on the airplanes in order to do the job.
>
> There really is no excuse for our not being able to put ordnance on a German airplane or vice versa, not to standardize these little things which can make such a tremendous difference in the operational effectiveness of our air forces. (22:21)

There are exceptions, of course. Some 500, 750, 1000, and 2000 pound "dumb" bombs can fit and correctly drop from most strike or attack fighters. Additionally, where nations use common aircraft like the F-16 there is some interoperability. Missiles, on the other hand, with the exception of some AIM-9 (Sidewinder air-to-air infrared guided missile) models, are not interoperable. The various nations cannot load other nation's weapons on their own or a third nation's aircraft. This is especially true with today's most effective conventional weapons: the precision guided weapons (GBU-10/12/15/24). Therefore, the realism that is "learned" through the assumed interchangeability of the various TWX 87 war gamed weapons portrays no where near the complexity that will be faced by the logisticians and operators in the NATO environment.(10:25-40) It may even be counterproductive training. In Korea, on the other hand, there is more similarity with the TWX munitions assumptions

because the Republic of Korea Air Force uses predominantly U.S. equipment and U.S. supplied weapons.

Finally, there is the one hundred percent lack of realism in spare parts portion of the game. Having a single generic part that applies to all aircraft and with depots in the theater that have stocks of aircraft spares is just too much aggregation that ignores important differences in classes of parts. Most U.S. spares are either already located at the intended air base, or in war readiness spares kits (WRSK--the spares needed by an aircraft unit deployed into combat for up to 30 days) which accompany those forces wherever and whenever they deploy. The remaining spares are in the repair or procurement pipeline, or are in storage facilities in the major depots in the United States. To get those parts to the intended base and aircraft takes strategic air or sea lift and considerably more that the one day distribution timetable gamed into TWX 87. Additionally, manufacturing techniques, aircraft technological age and national measuring systems do not allow for commonality among the national air forces. Even simple things like screws, nuts and bolts can be different because of metric and English measuring systems as well as differences in material make up. (An aluminum skin cannot take a steel screw, it makes a dissimilar metal battery which eats away at the aluminum.)

Transportation restrictions in TWX are probably as real as can be war gamed with one exception. In Europe, much of the transportation will be provided by the host nation via surface, whether rail or roadway. The roadways are modern, relatively hardened, and high speed. Railroad systems, as well, are modern, high speed and dense. Distances in Europe as well argue for using surface transport. The criticality of carefully managing tactical airlift resupply for air forces is made even more so because one would expect much of that mode to be dedicated to ground forces resupply and movement.

CHAPTER V

SOLUTION CONSIDERATIONS

If war games are one of the best methods for teaching our future leaders decision making and battle simulation, and if logistics is the most critical constraint for executing strategy and tactics, and if logistics is not now included in any meaningful way in Air War College war games, then what are we really teaching and what can be done to rectify the situation? How can the current theater war game, TWX, be made more "lifelike" and approximate the battlefield? Consider the following ideas as a starting point to adding to the computer model now in use for the TWX.

Computer War Games--some additions

To provide some realism in the logistics training in the TWX war game, consider adding computer models that already exist in the logistics area. For example, in maintenance and supply there are several computer models that have been designed to simulate and then predict personnel, parts, and munitions consumption in war time. One of those models is called Logistics Composite Model

(LCOM). LCOM is the model that is currently used by the Air Force--and is accepted by Congress--as one of the premier methods of justifying combat needs. It is the model against which tactical Air Force units are manned and parts are supplied in the War Reserve Spares Kit (WRSK). LCOM and a more localized model, Theater Simulation of Air base Resources (TSAR), are designed to take daily variable inputs to include mathematical probability of damage, clocks to approximate the failure rates of installed parts and subsystems, and can approximate the shop repair and pipeline-to-the-U.S. delay times for damaged spares. Additionally, LCOM and TSAR models are capable of providing for an analysis of aircraft regeneration times, using the normal turn around tasks to be performed, and are capable of using the fuel and ammunition consumption rates for measuring the total remaining stocks of those and other assets remaining on base. The constraint in these models, however, may be the amount of computer core time that it takes to run the simulation. Recall that other operational art factors, i.e. the simulated air war, are also running in the computer at the same time, as well as up to 20 other individual games.

If computer time is at a premium, there is a "first order approximation"(16:37) available that is designed to model a much more limited number of parts, systems, and

clocks as well as typical regeneration times and parts and support equipment delays. It is called the Expected-Value-Based Logistics Capability Assessment Model (ELCAM). It is designed to require limited computer time (it can be run on Zenith 100 and 248 minicomputers). It models maintenance and supply dynamics within 3-4 percent of the results predicted by TSAR. But there are drawbacks. ELCAM is less dynamic that TSAR or LCOM. "It does not handle substitute resources, facilities limitations, maintenance shifts, or resupply capability. It is not a self-contained, in-depth logistics analysis..."(16:37)

The Army developed a grouping of models in the 1970's that also deal with regeneration, (albeit with tanks, helicopters, and ground vehicles), with resupply (18:7-24), and with transportation (17:1-8). In fact, the system, called Simulation and Gaming Methods for Analysis of Logistics (SIGMALOG), was designed in several modules each dealing with a different part of the logistics system (maintenance, supply, and transportation). SIGMALOG is similar to the concept designed into LCOM with the addition of the transportation subsystem. More importantly, however, it is designed to be used as a gaming device as well as providing a device for helping senior leaders to simulate and model logistics requirements. As an aside, the SIGMALOG program, while antiquated by today's standards, is capable

of modeling contingency operations where no infrastructure is in place.

In the final analysis there are a number of analysis and modeling techniques that are in use by various branches of the military to forecast and simulate combat logistics functions. Some are in use for and as war games. If these could be adapted for use with TWX then the aggregated and perhaps unfortunately misleading logistics models now in use at the Air War College could be greatly enhanced. They would then provide more realistic training for the future generals and logistics warriors with real constraints on decisions. Additionally, by adapting rather than inventing, a proven, "debugged" program, TWX can be greatly improved with the least programming manpower to affect its implementation.

Logistics Reality--how much is enough?

There are literally millions of line items of supplies that support a given airbase. To manage the ordering, monitoring, and storage of those assets requires hundreds of people solely dedicated to that job, assisted by a complex computer system. The same is true with aircraft maintenance skilled personnel, ground support equipment, refueling trucks and underground dispensers, and certainly munitions build-up, storage, and fusing. That support cannot be

duplicated by a war game group or seminar of 10-13 people and a small computer. If, therefore, current TWX modeling is too unrealistic and one hundred percent realism is too difficult to model, what is the appropriate level of realism that should be portrayed in a TWX war game?

There is probably no exact answer, but there is a range of values that appear to approximate the "reality" rules without being unmanageable for a small group of people and a microcomputer. For this range of values consider some of the various models used for simulation of tactical theater war. The Multi-Base Sortie Generation Model (MBSGM) is one such model.

> MBSGM is a...model that simulates the aircraft turnaround process, including maintenance, aircraft battle damage repair, and quick turn procedures based on input parameters such as major subsystems reliability and maintainability and repair resource levels. Sortie capability is determined based on user inputs for tasking as well as repair and regeneration time distributions. User-scheduled external events, such as airfield attacks, may be added, as well as changes to original input parameters to simulate resource changes or varying time distributions.(5:C-01)

The key here is that this model is being used as a proven methodology to evaluate the effects on real world sortie generation of normal maintenance constraints which can be drawn, with some effort, from the Air Force Logistics Command reports detailing field experience with various

weapons systems. MBSGM is limited to a model consisting of up to 20 bases, two types of missions (air-to-air and air-to-ground), and 99 aircraft systems and subsystems. Yet even with these limited input variables, the model approximates actual sortie generation capability. (5:C-01-C-02) Additionally, "its performance has yielded consistent results which compare well with those of Rand's TSAR."(5:C-02)

TSAR, on the other hand, can model up to nine bases, five mission types, 320 different kind of personnel skills, 99 types of support and test equipment, 3199 types of parts, and 99 munitions types.(5:C-07) While the capability of the model is certainly greater than MBSGM, its reality approximation is about the same.

Therefore it would seem that to approximate a NATO-Warsaw Pact conventional air war in Central Europe what ever model is chosen would need to address up to 20 aircraft types and missions (which is about the number already addressed in TWX 87), up to 100 kinds of spares parts and subsystems, up to 20 types of munitions (not all of which fit on every aircraft type or nationality), and would have to incorporate some accounting for 10-20 logistics personnel skills and their redistribution in order to recover aircraft that had been damaged at a non-military location. Additionally, the transportation model might have to include

accounting for some amount of road transportation (it would not be difficult to approximate the actual number of USAFE or NATO assigned over the road trucks) and the actual number of tank cars now in Europe for fuel distribution.

In conclusion, there is no absolute set of numbers that is a correct model for logistics realism in a TWX scenario. But the MBSGM shows that with only a moderate increase in the numbers of spares, munitions, and transportation variables a model can significantly increase its approximation of the complexities of combat logistics.

CHAPTER VI

CONCLUSIONS

The business of the Air War College (AWC) is to prepare future leaders to successfully prosecute an air war should that eventuality become necessary. That preparation is in the form of historical studies, war theory studies, and some sort of integrating study such as war games. One of the war games offered at AWC is the TWX. It is designed to be an operational art or theater tactics exercise. But a careful study of the game reveals serious flaws in its logistics portions. These logistics support scenarios are too aggregated to accurately reflect what we expect to happen when the war starts. There are generic parts, generic aircraft models, generic transportation models, and precious little flexibility in the logistics module. This type of war gaming has several dangers. First, since it does not allow for the important effects in the battlefield environment, it tends to support the current logistics force structure which does not account for them either. As Colonel Robert Tripp notes, these are just the things we should be considering:

> The current base and depot level systems were developed for a steady state environment in which

> demands are easily predictable and dynamic disruptions to the base support structure are not viewed as likely. Bases are designed essentially to depend on requisitions flowing to the depot and being satisfied in some orderly sequence. That is not the kind of structure that can support operational forces in a highly dynamic war.(20:25)

The second is, as Colonel W.T. McDaniel suggests, that "the real danger of these training inadequacies is that commanders do not fully appreciate the impact of logistics on operations. And, logisticians will be unable to assist the commander because they have not been educated to handle the enormous detail of a major operation at the theater and global level."(14:14)

A benefit of war gaming is foregone by keeping the logistics play of TWX so simple. Recall the benefits derived from the "loss" to the red (British) fleets because of the longer firing ranges of the British warships. Recall too the solution that resulted from these war games. That factor was also prevalent in the sturdier armor plating given to U.S. Naval ships as a result of war games. The "solution" to the kamikaze problem was also afforded because of war gaming. If AWC war games are as realistic as can be, even if there has to be an unclassified game for our foreign students (like TWX 87) and a classified, up-to-date game for U.S. officers, then there is a possibility that students and future leaders can not only gain an appreciation for the

problems of logistics, but add to the body of knowledge that can help correct realtime logistics shortfalls.

In conclusion, it is every officer who must understand the impact of logistics on his operations.

> "It [logistics] is the economics of warfare, and it comprises, in the broadest sense, the three big M's of warfare--materiel, movement, and maintenance. If international politics is the art of the possible and war is its instrument, logistics is the art of defining and extending the possible. It provides the substance that physically permits an army to live and move and have its being."(11:vii)

Most importantly, it might be well to remember the final conclusion reached by the senior combat leaders in World War II in both the Pacific and European theaters of war: "logistics limitations in many cases dictated our strategy, as well as the type of campaign to be fought and the timing of its initiation."(13:244) There is no stronger statement that a commander can make than to say his operations are driven by a particular subset of his command. But if a more recent and direct statement is appropriate, then consider a U.S. Air Force wing commander's comment in the Airpower Journal. "Although it is not the most glamorous of the wing commander's duties, maintaining the logistics base is perhaps the most critical."(12:23)

In the final analysis, the Air War College is the ultimate professional education experience in the Air Force. If, in the words of a recent four star AWC lecturer, who attributed them to author Tom Clancy, "amateurs talk tactics, professionals talk logistics", then a professional experience in Air War College should be to talk logistics during TWX.

LIST OF REFERENCES

1. Allen, Thomas B. War Games. New York, NY: McGraw-Hill, Inc. 1987.

2. _____. "A Scenario for Armegeddon: The Grim Unrealities of War Games." Sea Power, July 1987. pp 39-48.

3. Basic Doctrine of the United States Air Force, (AFM 1-1). Washington, DC: U.S. Government Printing Office. 16 March 1984.

4. Brown, Colonel Kenneth N. Strategics, the Logistics-Strategy Link. Washington, DC: National Defense University. March 1987.

5. Catalog of Computer Models and Programs used by the United States Air Force Center for Studies and Analysis. Washington, D.C.: Air Force Center for Studies and Analyses. October 1985.

6. Combined Air Warfare Course. "Theater War Exercise Users Handbook 1987". Maxwell AFB, AL:Center for Aerospace Doctrine, Reasearch, and Education, Air University. 1987.

7. Dupuy, Colonel (USA Ret) Trevor N. "Can We Rely on Computer Combat Simulation?" Armed Forces Journal International. August 1987. p 58.

8. _____. Numbers, Predictions, and War. Indianapolis, IN: Bobs-Merrill Company, Inc. 1979.

9. Eccles, Rear Admiral (USN Ret) Henry E. Logistics in the National Defense. Harrisburg, PA: The Stackpole Company. 1959.

10. Edwards, Lieutenant Colonel Herbert H., Hancock, Lieutenant Colonel Robert N., Noakes, Lieutenant Colonel Richard C., Parker, Lieutenant Colonel Billie H., Paul, Colonel Herbert D., Reed, Colonel David E., and Stowell, Lieutenant Colonel Dibrell C. NATO Logistics: Factors Affecting Theater Air Warfare with an Outline of a Unified Commander's Basic Logistics Plan. Maxwell AFB, AL: Air War College, Air University. April 1977.

11. Huston, James A. The Sinews of War: Army Logistics 1775-1953. Washington, DC: U.S. Government Printing Office. 1966.

12. Krieger, Colonel Clifford R. "Fighting the Air War". Airpower Journal, Summer 1987. pp 21-31.

13. Logistics in World War II. Washington, DC: The War Department. 1947.

14. McDaniel, Lieutenant Colonel William T. "Combat Support Doctrine: Coming Down to Earth". Air Force Journal of Logistics, Spring 1987. pp 13-16.

15. Perla, Peter B. "War Games, Analyses, and Exercises." Naval War College Review, Volume 40, Spring 1987. pp 40-52.

16. Rice, Major Roy E. "An Expected-Value-Based Logistics Capability Model (ELCAM)." Air Force Journal of Logistics, Fall 1987. pp 34-37.

17. Roelfs, Thomas, B., Fuelling, Clinton P., and Rowan, Jeanne W. Simulation and Gaming Methods for Analysis of Logistics (SIGMALOG): Theater Transportation Model. McLean, VA: Research Analysis Corporation. September 1971.

18. Roelfs, Thomas B., Fuelling, Clinton P., and Henke, William P. Simulation and Gaming Methods for Analysis of Logistics (SIGMALOG): Major Item Resupply Model. McLean, VA: Research Analysis Corporation. August 1971.

19. Rutenberg, Lieutenant Colonel David C. and Allen, Jane, Eds. The Logistics of Waging War. Gunter AFS, AL: Air Force Logistics Management Center. 1985.

20. Tripp, Colonel Robert S. "Strategies for Logistics C3I". Air Force Journal of Logistics, Spring 1987. pp 23-39.

21. Van Creveld, Martin C. Supplying War. London, England: Cambridge University Press. 1977.

22. Vogt, General John W. (USAF-Ret), Statement during a Hearing on Problems in the Standardization and Interoperability of NATO Military Equipment before a subcommittee of the Committee on Government Operation, U.S. House of Representatives, 95th Congress. Washington, D.C.: U.S. Government Printing Office. 21 July 1977.

ADDITIONAL REFERENCES

Beyer, Alfred H. and Stevenson, Conelly D. Depot Maintenance in the 1990's. Bethesda, MD: Logistics Management Institute. July 1986.

Cook, Major Jeffrey W. NATO Logistics Support: Process and Perspective. Maxwell AFB, AL: Air Command and Staff College, Air University. 1981.

Eccles, Rear Admiral (USN Ret) Henry E. Notes on Military Concepts. Washington, DC: George Washington University (Logistics Research Project). 7 March 1961.

Harmon, Colonel Daniel K. Developing an Appreciation in Force Structuring and Employment using the Command Readiness Exercise System for Wargaming. Maxwell AFB, AL: Air War College, Air University. February 1983.

McMahon, Lieutenant Colonel Gary C. Air Force Logistics Doctrine: Where is it? Maxwell, AFB, AL: Air War College, Air University. May 1985.

Scheiding, Colonel David O. Logistics and Tactical Readiness--Are They Compatible? Maxwell, AFB, AL: Air War College, Air University. March 1986.

Shaw, Lieutenant Colonel William C., Jr. Logistics Support for Deployed Forces. Maxwell AFB, AL: Air War College, Air University. May 1984.

Thorpe, Lieutenant Colonel George C. Pure Logistics. Washington, DC: National Defense University Press. 1986.